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ENVIRONMENTAL VARIATION IN *HETEROTHECA SUBAXILLARIS*

C. JOHN BURK

A weedy composite, *Heterotheca subaxillaris*, is a prominent member of the dune-grass community on Bogue Barrier, the most southern island of the North Carolina Outer Banks. The plant occurs not only on the open dunes, but also along roadsides and pathways through the shrub zone and into the pine-oak-hickory forest which covers those portions of the island which are most protected from salt spray. The plants on the dunes are low-growing, nearly prostrate forms. The plants in the pine-oak-hickory forest grow erect and to a height of a meter or slightly more. The plants occurring in the shrub zone are intermediate in size between these two extremes.

While most of these plants flower in late summer and early fall, one population (which occurred on both sides of the road adjacent to the bridge which connects the north end of the island with the mainland) was observed in flower all the year-round, some eighty plants being in full bloom on January 19, 1960. Most of the other *Heterotheca* plants on the island were in winter-rosette form at that time. The winter-flowering specimens resembled a plant described by Benke (1928) as *H. subaxillaris* var. *petiolaris*. They were shorter than typical *H. subaxillaris* and more densely pubescent. While a few of the flowering heads were aborted and deformed, most of the capitula were larger (more than a centimeter in diameter) than those of typical *H. subaxillaris*. They flowered on short branches sent up from a persistent rosette, and, as Benke had noted, were very similar in appearance to plants of the closely allied genus *Chrysopsis*.

Stem cuttings were made from portions of the basal rosettes of a number of these plants, and clonal pairs of cuttings were placed, one on short day (9 AM to 5 PM) and the other on long day (dawn to 11 PM) in the greenhouse at the University of North Carolina. Winter rosettes of typical *H. subaxillaris* had been brought into the greenhouse and placed on long and short days on December 9, 1959.

The winter rosette specimens flowered within two months on long day (2 plants); they did not flower at all on short day but remained in vegetative condition until early May of 1960 when the experiment was concluded. The clone-cuttings of the winter-flowering plants which had been placed on long day rooted quickly and began to flower within a month. The ones on short day rooted rather tardily. Many of the latter plants died. One of them flowered on April 26, 1959, and on May 2, two more plants were in bud out of a total of eight surviving cuttings. Of the long-day members, eight had flowered out of fifteen which had survived.

It would appear from these preliminary experiments that typical *H. subaxillaris* requires long days to flower whereas Benke's variety *petiolaris* will flower on long or short day-lengths. It might be noted that the portion of the Outer Banks from Bogue Barrier north past Cape Hatteras is an "island" of localized mild climate along a coastline which, northward and southward, is more rigorous. The ability to flower all the year-round might well be a selective advantage under these conditions.

In March and April of 1960, while these experiments were in progress, a revision of *Heterotheca*, Section *Heterotheca*, was published (Wagenknecht, 1960). In this work *H. subaxillaris* var. *procumbens* was described. The description of this variety coincided exactly with that of the plants in the dune-grass community on Bogue Barrier, and it was suspected that *H. subaxillaris* var. *procumbens* might be an ecotypic derivative of typical *H. subaxillaris*.

Thirty established plants of the beach variety and 30 established plants from the populations of tall-growing *H. subaxillaris* from the pine-oak-hickory forest were transplanted from Bogue Barrier to alternating rows in the Botanical Gardens of the University of North Carolina in early June

of 1960. At the time of transplanting, the plants from the pine-oak-hickory forest had begun to bolt whereas those from the dunes had not. The transplants were watered only at the time of transplanting. After that, they were exposed to normal meteorological conditions. They were grown on a poor clay soil to which no fertilizers had been added. Nevertheless, both sets of plants grew very well in Chapel Hill and, under the virtually uniform conditions provided in the Botanical Garden plots, developed into virtually identical sets of plants. The heights of the transplants and the length of the longest stem of each are given in Table 1. The ratio of the height to the length may be considered a general measure

TABLE 1. Height, length, and height/length ratio of *H. subaxillaris* from dune and pine-oak-hickory populations contrasted with height, length, and height/length ratio of plants from the same populations grown in a uniform environment. 20 plants from each population were measured in centimeters and the longest stem of each plant was used for length measurement.

	Dune-grass ecads	Forest types	Dune-grass transplants	Forest transplants
height range	17-35	55-100	104-148	94-157
average height	27	81	124	121
length range	21-48	68-103	106-154	94-160
average length	33	86	129	124
height/length	.82	.94	.96	.97

of the degree of procumbence. Included in Table 1 are the heights and lengths of 20 specimens taken from each of the two populations on the island from which the transplants had been removed in June. These two latter sets of plants were collected on October 13, 1960; the transplants were uprooted and measured on October 18.

It would appear from the data that the Bogue Barrier plants referable to *H. subaxillaris* var. *procumbens* reflect the response of a common genotype to more rigorous environmental conditions. The other characters separating the variety from the species (degree of serration of the leaves, prominence of lateral veins) are subjective at best and were quite useless in separating the two sets of plants grown in the uniform environment from one another.

The recent revision placed *H. subaxillaris* var. *petiolaris* in synonymy with *H. latifolia* Buckley. While the probable

photoperiodic nature of the variations in Benke's plant was recognized (it had been collected in March), it was considered to be a deviant of the western species *H. latifolia* on the basis of its heavy pubescence. Examination of the sites upon which the photoperiodic variant occurs revealed no specimens referable to *H. latifolia*, as described in the revision, although numerous plants of typical *H. subaxillaris* were encountered. It would seem more likely that the day-neutral plants on Bogue Barrier were variants of the species already abundant on the island than that they were plants of a separate introduced species.

One of the principal characters used to distinguish *H. latifolia* from *H. subaxillaris* is the tendency of *H. latifolia* to grow as much as two meters in height while *H. subaxillaris* does not exceed one meter. An examination of Table 1 shows that this criterion is not valid. It should be mentioned that a specimen of *H. subaxillaris* from Bogue Barrier was cited in the revision as a representative specimen. The heavier pubescence attributed to *H. latifolia* and encountered in the winter-flowering plants on Bogue Barrier likewise does not appear to be a valid criterion for distinguishing two taxa since clonal plants of typical *H. subaxillaris* also developed the heavy pubescence when grown in the greenhouse over winter, regardless of the daylength to which they were exposed, "losing" the heavy pubescence when grown in the Botanical Gardens over the summer.

Thus it would seem preferable, for the time being, to retain the former concept of *H. subaxillaris* as a single, highly variable species until a more extensive study of the effects of different environments upon its forms is made.

Specimens representing all environmental variants cited, both naturally occurring and experimentally induced, have been deposited in the herbarium of the University of North Carolina. — DEPT. OF BOTANY, SMITH COLLEGE, NORTHAMPTON, MASS.

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